years (± 15.3), mean BMI of 25.8 kg/m2 (± 4.7) and 52% female) were acquired on a 3T Signa HDx MR (GE Healthcare, Piscataway, NJ) scanner with an 8-channel phased array knee coil. Sagittal cartilage T1ρ and T2 maps were generated using 3D MAPSS mapping techniques (TR/TE=9.3/3.7 ms; FOV=14cm, matrix=256×128 pixels, slice thickness=4 mm, BW=31.25 kHz, views per segment=64, recovery time =1.5 s, for T1ρ: Time of Spin-Lock=0, 10, 40, 80 ms, spin-lock frequency=500 Hz; for T2: prep TE=4.1, 14.5, 25, 45.9 ms). A fat-saturated T1-weighted 3D SPGR sequence (TR/TE=15/6.7 ms, flip angle=12, FOV=14cm, matrix=512 × 512, slice thickness=1 mm, bandwidth=31.25 kHz, NEX=1) was used for cartilage segmentation.

Five cartilage knee compartment regions of interest (ROIs) (lateral femoral condyle (LFC), medial femoral condyle (MFC), lateral tibia (LT), medial tibia (MT), patella (PAT)) were segmented in a MATLAB (MathWorks, Natick MA) based in-house software package. Compartments were partitioned into a bone and articular layer, using a Euclidean distance algorithm with the same in-house software. A random effects linear regression model adjusting for age, gender, and BMI was performed in JMP software version 8 (SAS Institute, Cary NC).

Results: Statistically significant increases in both T1ρ and T2 ($p<0.01$ respectively) relaxation time constants were observed in the MT for the pain group (figures 1 and 2) when compared to the asymptomatic cohort. In analysis of the cartilage layers, MT bone layer T1ρ ($p<0.01$), MT bone and articular layer T2 ($p<0.01$ respectively), and LT bone layer T2 ($P<0.05$) were also significantly elevated in the pain cohort.

Conclusions: This study shows a significant relationship between knee pain and cartilage T1ρ and T2 relaxation time mapping, metrics for early cartilage degeneration. Subjects reporting moderate to severe knee pain as determined by the WOMAC questionnaire displayed elevated T1ρ and T2 relaxation time constant in the MT, indicating that cartilage degeneration in this compartment may be related to noticeable pain symptoms. Furthermore, the laminar analysis shows that the elevation of T1ρ and T2 in the pain group is more dominant in the bone layer, implying the cartilage and bone interaction may contribute to the association between cartilage degeneration and pain.

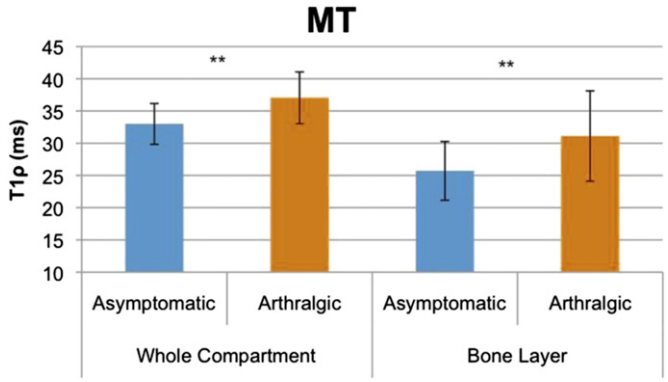

Figure 1. – Medial tibia whole compartment and bone layer T1ρ for both asymptomatic and arthralgic groups. Single asterisk denotes $p<0.05$ and double asterisk denotes $p<0.01$.

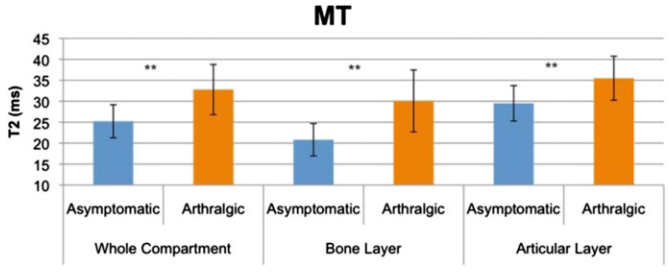

Figure 2. Medial tibia whole compartment, bone, and articular layer T2 relaxation time constants for both asymptomatic and arthralgic groups. Single asterisk denotes $p<0.05$ and double asterisk denotes $p<0.01$.

370

SONOGRAPHIC ASSESSMENT OF HYALINE CARTILAGE THICKNESS IN THE KNEE AT DIFFERENT VIEWS DISTINCT FROM THE STANDARD VIEW WITH THE KNEE FULLY FLEXED

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Purpose: Studies of cadavers or pathological specimens from post-surgical knee arthroplasty patients have shown that the measurement of femoral articular cartilage thickness (FACT) is accurate and reproducible by ultrasound (US). US can be used in the assessment of the cartilage damage in patients with rheumatic disorders, particularly osteoarthritis of the knee. However, the traditional method of using ultrasound to measure cartilage thickness requires hyperflexion of the knee, which is often a difficult maneuver for these patients. The aim of this study was to find an effective alternative method to measure the FACT by US, using a minimally flexed or an extended knee.

Methods: Twenty right knees from twenty recruited volunteers (13 females and 7 males) with a mean age of 32.6 (range 22-52) years were evaluated by US using a GE Logiq e machine equipped with 8-13 MHz linear transducer. The FACT was measured in transverse view with the knee fully flexed. Two longitudinal views of the medial and lateral femoral condyles (FC) were obtained at the anterior aspect with the knee flexed at 140° and at the posterior aspect with the knee extended (Figure). The intraobserver agreement of the thickest of the FACT measured by a rheumatologist with US experience was assessed in each view in 20 knees. An intraobserver and the interobserver agreement of the different views between two operators was evaluated in 6 knees. Spearman's correlations were used to assess the correlation between different views. Wilcoxon Signed Ranks tests were used to check for average differences.

Results: Overall, the correlations of other views with the fully flexed (gold standard) view were good (0.85 or higher) for both raters with the exception of the lateral FC in the posterior view of the extended knee. The correlation between the two operators was strong (above 0.95) for all views except the posterior lateral FC [Rho=0.638, p=0.173]. There were no significant mean differences between fully flexed and the other views within rater, nor for corresponding views between raters. Absolute value differences between views and raters were generally small, except for some larger discrepancies involving the extended lateral view. The mean of thickest FACT was 20 mm (SD 3.79) for the lateral FC and 20.4 mm (SD 3.48) for the medial FC at the standard view. In a longitudinal view with the knee flexed at 140° it was 20.3 mm (3.5 SD) for the lateral FC and 20.3 (3.78 SD) for the medial FC. In the posterior view with the extended knee the mean of the FACT for lateral and medial FC was 19.1mm (3.9 SD) and 20.7 mm (3.6 SD), respectively.

Conclusions: Sonographic assessment of the FACT using the longitudinal anterior view with the knee at 140° of flexion and at the posterior aspect with extended knee at the medial FC demonstrated good comparability to the gold standard fully flexed knee. Further studies are required to explore the use of these measurements as a surrogate of the standard view in patients with knee osteoarthritis with restricted flexion of the knee.